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ABSTRACT

Learning medical terminology requires an ability to memorize word definitions, to spell the words, and to know the meaning of word parts so that new words can be analyzed. Students who enroll in the medical terminology course at California State University, Fresno, come from a variety of backgrounds, abilities, and directions. Past experience shows that roughly as many students attain a final course grade of "A" as do students who attain grades of "D" or "F." To encourage self-study outside of class, a series of self-study slide-tape modules were developed. Shortly after that, a computer program was modified to be used for self-study of medical terms. This research project was conducted to determine which method resulted in higher examination scores. Stratified random sampling techniques were used to assign students to the computer (N=22) or to the slide-tape modules (N=24). At the end of the semester, final examination scores for both groups were tabulated. No significant differences were found using a two-tailed t-test. Therefore, faculty have been advised to direct students to their preferred method of study (slide-tapes, computer, or both). (Author/JN)

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A COMPARISON OF MEDICAL TERMINOLOGY EXAM SCORES OF STUDENTS STUDYING BY COMPUTER WITH STUDENTS STUDYING BY SLIDE-TAPE

by

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ABSTRACT

Learning medical terminology requires an ability to memorize word definitions, to spell the words, and to know the meaning of word parts so that new words can be analyzed. The students who enroll in the medical terminology course at California State University, Fresno come from a variety of backgrounds, abilities, and directions. Past experience shows that roughly as many students attain a final course grade of "A" as do students who attain a final course grade of "D" or "F". To encourage self-study outside of class, a series of self-study slide-tape modules were developed. Shortly after that, a computer program was modified to be used for self-study of medical terms. As an aid to students, and to aid the instructor of the course in student advisement, this research project was conducted to determine which method of self-study resulted in higher exam scores: computer-based self-study or slide-tape-based self-study.

Stratified random sampling techniques were used to randomly assign students to the computer or the slide-tape modules. Both the computer program and slide-tape modules were designed to closely follow lecture materials presented in the medical terminology class. At the end of the semester, final exam scores from both groups were tabulated. A two-tailed t-test was done to determine if there was a significant difference at the .05 level between exam scores of students doing self-study by computer and those doing self-study by slide-tape modules. No significant differences were found. Faculty have been advised to direct students to their preferred method of study--slide-tapes, computer, or both.

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INTRODUCTION

The medical terminology course offered at California State University, Fresno (CSUF) is a two-unit course taught by faculty from the physical therapy program. Open to all majors, this course is strongly recommended to students planning to apply for admission into the physical therapy program. Therefore, the majority of students who enroll in the class are prephysical therapy majors or students already in the physical therapy program. A small number of students from other areas such as nursing, health science, physical education, and business comprise the remainder of the class.

Studying medical terms has been described by some students as being as exciting as studying a dictionary. It takes time and discipline to memorize new words and word definitions. To encourage student self-study independent of lectures, a fifteen-unit slide-tape module and accompanying workbook were developed in 1979 (Dunkle). The slide-tape modules closely follow the lectures and include quizzes similar to the midterm and final exams. To provide variety, and as a result of encouragement from personnel at the computer center at CSUF, a self-study computer program was developed in 1980 which also closely follows the course lectures and includes quizzes similar to the midterm and final exams.

In 1980 the students in the medical terminology course were given their choice of whether to do their self-study by computer or by slide-tape. The computer program was apparently a novelty and the

enthusiastic comments students made caused many of their classmates to switch from slide-tape to computer and back again. Thus, it was not apparent which method of study was the most helpful.

The wide cross-section of students who enroll in medical terminology seems to include many levels of learning abilities. Often there are as many final course grades of "A" as there are of "D" or "F". Eager to prove the effectiveness of the computer as a learning tool, personnel at the computer center at CSUF have suggested that students who do self-study by computer will earn higher grades than students who do self-study by slide-tape modules. Thus far the conjecture has been unproven since students have not previously been randomly assigned to either the computer or the slide-tape modules, and no efforts have been taken to prevent students from switching back and forth from the two methods of self-study.

STATEMENT OF THE PROBLEM

Traditionally there have been a high number of students who enroll in the medical terminology class who receive final grades of "D" or "F". Often students would report at the beginning of the semester that they had difficulty with spelling or with memorizing words. These students in particular, to ensure success or at least improve their chances of success, should have been directed toward the most effective method of self-study.

It would be useful to determine whether self-study of medical terminology by computer results in higher test scores than self-study of medical terminology by slide-tape modules. Is computer-assisted self-study of medical terms more effective in terms of test scores earned

than self-study by slide-tape module, or vice versa? If one method was found to be more effective than the other, the instructor could encourage students to study by that method. Thus, the students would be more successful in this course, and fewer low grades would be earned.

RESEARCH HYPOTHESIS

There is a difference in the mean test scores between students learning medical terms by computer-assisted self-study and students using slide-tape modules for self-study.

BACKGROUND AND SIGNIFICANCE

In the past, students enrolling in the medical terminology course at CSUF have been given a choice as to whether they will conduct their self-study by specifically developed computer programs or by slide-tape modules. These programs and modules have been developed to closely follow the class lectures and to include quizzes similar to the midterm and final exams. Traditionally there have been almost an equal number of high course grades as there have been low and failing grades in this course. If it could be shown that self-study by either the computer or the slide-tape modules resulted in higher test scores, that method identified as producing the highest test scores could be recommended to the students at the beginning of each semester. This information could be particularly helpful in advising those students who entered the course knowing that they had difficulty with spelling and memorization. Students who began the semester knowing that they had no problems with spelling or memorization might be given a choice of their method of self-study.

The outcome of this practicum would provide useful advising information for the faculty of the Physical Therapy Program. Properly advised students would be more successful in learning medical terminology (as judged by exam scores). Since students from several disciplines enroll in the medical terminology course, the institution (university) would benefit by having students better prepared to go into upper division courses where knowledge of medical terminology is essential. The outcome of this study could be shared with other faculty at the university who are developing self-study materials, and perhaps guide them as to the type of media they wish to develop. In addition, there is scarcity of reported research which compares computer study to study with other media. This practicum may pave the way for such future studies.

This project was appropriate for the seminar "Applied Educational Research and Evaluation." It applied the principles of problem identification, research design, development of a hypothesis, stratified random sampling, and used statistical formulas (t-test) to determine whether the results were significant. The principles of the seminar were applied in this practicum.

The historical picture of educational tools developed for self-study might begin with Postlethwait who in 1961 developed "audio-tutorial" instruction to assist students in a botany class (Postlethwait, 1972). He later expanded his use of audio-tutorial instruction to other areas. This method of study, which he also referred to as "A-T", was basically a tape-directed study or project which students used to reinforce what they were learning in the classroom. The advantages of such a system were that it reinforced learning, provided repetitive

review, and allowed students to study when it was convenient to their own schedule. Such a system has been expanded upon and is in use in several institutions of higher learning, where the concept of audio-tutorial has been expanded to include slide-tape modules and film strips (Machie, 1981).

Learner characteristics enter into media selection for self-study or self-tutorial methods. For instance, poor readers tend to do better hearing spoken words than reading written words. Poor readers do best with pictures. Passive, submissive learners do best by teacher-led work, while independent learners do best by programmed instruction or self-directed study (Briggs, 1970:95).

In the 1960s programmed learning was quite popular and continues to be so today, in some areas. Programmed learning consists of booklets, or chapters of printed materials presented in a sequenced, logical manner. Often machines are used to progress the student through the printed materials. Throughout the lesson, students are required to give responses or answer questions about materials just learned. Depending on the accuracy of their answers, students may be asked to go back and review previous materials, or to progress to another section. Keeping students motivated and progressing them at a rate corresponding to their level of comprehension appears to be the biggest problem with programmed learning (Espich, 1967; Briggs, 1970). Computers have replaced the written forms of programmed learning for the most part. Today the phrase "programmed instruction" is commonly used to refer to any carefully sequenced presentation, whether it is by book, lecture, teaching machine, or film (McKeachie, 1969:93). McKeachie reminds instructors that students who score high on sociability tests tend to

do poorly with programmed instruction.

Slide-tape modules have been in use for some time in education. The advantages of slide-tape modules are that they are easy to prepare and relatively inexpensive. They appeal to students who learn easily through visual and/or auditory means. Slide-tape modules can easily be stopped and replayed by the student. They can be viewed at the student's convenience (Brown, 1971:151).

The use of the computer to assist in education was initiated in the U.S. in the late 1950s and early 1960s (Chambers, 1980). Expenses of computers, technicians, software, and lack of instructor's knowledge of computers may have contributed to its rather limited acceptance initially. Over the past few decades technological improvements in size and cost of computers, plus new and easier to learn computer languages, have allowed computers to become standard equipment on most college campuses. Computer-assisted instruction can either supplement the learning situation, or substitute for other modes of instruction. In most instances, instructors select computers to supplement learning.

The advantages of computer-assisted learning are quite similar to the use of slide-tape modules. The individual is involved actively in the learning process. The learner may proceed at his own pace. The student may receive immediate feedback. Disadvantages of the use of computers are the expense, lack of acceptance by educators and/or students, lack of availability of software or appropriate programs, and frustration of users because of lack of knowledge about computer language. (Students frequently complain of difficulty in logging into a computer, or of being cut off when the computer shuts down in the middle of a learning module.)

Research comparing the effectiveness of computer learning to slide-tape module learning is apparently scarce or nonexistent. The ERIC documents of the last fifteen years show no such studies, nor can reports be found in the Education Index (Hewitt, 1982). Levien (1972) reports a study done at Florida State University where computer studies supplemented traditional lecture in a physics course. Data indicated a 17 percent reduction of instructional time, and higher scores on final exams by students studying by computer. In another study reported by Levien (1972), students studying Russian were placed in a control group receiving traditional lectures, and an experimental group receiving computer tutorials in addition to the lectures. Students studying by computer scored significantly better on final exams.

Several studies show that the use of computer instruction either improves learning or shows no differences when compared to the traditional classroom approach (Deignan, 1978; Splittgerber, 1979). Chambers (1980) reports that low aptitude students profit more from the use of computer-assisted study than either average or high aptitude students. McKeachie (1969:97) wrote of a study comparing computer-assisted college level instruction to conventional instruction with programmed texts. Results were a savings in time and improved performance by the students studying by computer.

Pohl (1981) reported a study comparing computer-assisted instruction (CAI) to lecture/discussion in terms of student achievement and retention. No significant differences were found. When planned student-teacher contacts were added to CAI, students did significantly better than lecture/discussion alone, or lecture/discussion with planned student-teacher contacts.

Computer-assisted instruction added to traditional instruction has been found to increase student achievement (Burns, 1981). There is some evidence that it may also increase the rate of learning (Magison, 1978), although similar claims have been made for programmed instruction. Holmes (1982), in reviewing claims for computer-assisted instruction, felt that most experiments show CAI to be as effective as traditional instruction, with little evidence that it is significantly more effective. He felt that the main advantages of computer learning are that it frees the teacher for more student interactions and is useful for presenting basic information, drill and practice, remedial work, or providing immediate student feedback. Cadzella (1982) found CAI effective in improving student study skills and attitudes.

Masuo (1981) recognized that little research had been done comparing the effectiveness of CAI to other media of structured presentation. She chose to compare a programmed text to a computer self-study program to teach credit cost concepts. No significant differences were found by comparison of exam scores, although students of low aptitude performed better when studying by computer than by programmed text. This supports Chambers' findings, as mentioned earlier (Chambers, 1980).

The above studies all support the use of computer-based instruction, but as stated previously do not compare the effectiveness of self-study by computer with self-study by slide-tape modules. Few studies are to be found that compare computer study to other media. In that aspect this study may be somewhat unique. This review represents a historical perspective of research in this area up to the 1980s.

DEFINITION OF TERMS

The following terms are defined to prevent ambiguity in the interpretation of this study:

Self-study: Time beyond that spent in the classroom, in which the student studies materials presented in lecture. This is study time outside of class, done at the student's convenience.

Physical therapy students: Students who have been accepted and are currently enrolled in courses within the physical therapy program at CSUF.

Prephysical therapy students: Students who have declared physical therapy as their major and who are enrolled in general education courses and prerequisite courses to the physical therapy program. They have not yet been accepted into the program.

Slide-tape module: A series of instructional units in which the material being presented is illustrated on slides which are in sequence with an accompanying narrative on audiocassette.

Computer-assisted instruction: Use of study by computer to supplement the learning situation, rather than substitute for other modes of instruction. For this study a program titled "MEDTRM" from Georgia State University was used as a model (Rau, 1979). MEDTRM was modified to correlate with materials presented in the medical terminology class at CSUF.

LIMITATIONS OF THE STUDY

Sample size for this study was small, consisting of forty-six students. The study was done on only those students who happened to enroll in the medical terminology class during the fall semester 1981.

Thus, students were not selected randomly. They were, however, randomly assigned to do their self-study by either computer or slide-tape module. Because of small sample size, inferences made to students in general must be guarded.

There was a possibility of contamination of information between students studying by different methods. Students who were friends often studied together and shared information, as well as perhaps use of the two types of self-study methods available in this course. This variable could not be controlled except by asking students to study only by the mode they were assigned. The danger of this approach was that the students would then be aware that they were part of a study and change their normal study habits.

Results of this study apply only to the slide-tape modules developed for the medical terminology course at CSUF and to the computer program modified for the course. A broad generalization as to whether computer self-study is better than slide-tape self-study in other courses cannot be made without reservation. Also, by nature of the equipment used, material presented in the computer program was not identical to material presented in the slide-tape modules.

BASIC ASSUMPTIONS

It was assumed that students who were assigned to do their self-study by slide-tape module would not switch to computer study during the semester. It was also assumed that students who were assigned to do their self-study by computer would not switch to the slide-tapes during the semester. Although the students were assigned to one of two methods of self-study, it was assumed that they would not know they were

part of a study, which might influence or change their behavior. A final assumption was that the students would actually use the self-study methods.

PROCEDURES FOR COLLECTING DATA

Students of varied backgrounds and majors traditionally enroll in the medical terminology course at CSUF. These variables could have influenced the outcome of this study. Thus, stratified random sampling techniques were used. Students were classified as to whether they were prephysical therapy, physical therapy, or other majors, and also according to gender. Extremes of ages were classified. Then a table of random numbers was used to randomly assign the students to self-study by either computer or slide-tapes.

Individual passwords were given to each student who was to study by computer so that they could log onto the program. Instructions were given that they should not share their password with anyone. The slide-tape modules were available at only two places on campus. At each location a list of names was posted for the clerk to verify which students could check out the slide-tape modules. The clerks were instructed not to check out the modules if the student's name did not appear on the list.

Data collected were scores from the final exams. These exams were very similar to exams used over the same material in the past. Because exams have not in the past been returned to the students to keep (by the instructor's policies), there should have been no problem with copies of the exams being circulated. The exams tested the student's ability to spell, define, and divide words into word parts, as well as to form new words from word parts discussed in class. For

this particular study, data collected were only the final exam scores without breaking scores down into area tested. The exams had internal validity in that they covered the material presented in class and were based on course objectives that were shared with students at the beginning of the semester (Appendix A). The exams were specific to the course and therefore their external validity was questionable, except as they would relate to a course taught in a similar manner (Appendix B).

PROCEDURES FOR TREATING DATA

For both groups of students, those who did self-study by computer (C) and those who did self-study by slide-tapes (ST) the scores of the final exams were totaled. The final sum scores were used to determine the mean scores and standard deviations for groups C and ST. A t-test was used to determine if there was a significant difference between the means of group C and group ST, for significance at the .05 level (a two-tailed independent t-test).

The formula used was as follows: $$t = \frac{X_1 - X_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

The formula used for degrees of freedom was

$$df = n_1 + n_2 - 2$$

These formulas were taken from Burton (1981:59) and Mendenhall (1971:224).

Null hypothesis (Ho): There is no difference in the mean test scores between students learning medical terms by computer-assisted self-study and students using slide-tape modules for self-study.

Ha_1: Mean test scores of students doing self-study by computer are significantly greater than those studying by slide-tape modules (.05).

Ha_2: Mean test scores of students doing self-study by computer are significantly less than those studying by slide-tape modules (.05).

The independent variables in this study were the computer self-study program and the slide-tape self-study modules. The dependent variable was the test scores earned by the students.

DATA RESULTING FROM THE STUDY

Of the original fifty-one students who registered for the course, stratified random sampling procedures resulted in twenty-six students assigned to self-study by computer (Group C) and twenty-five students assigned to self-study by slide-tape (Group ST). Five students later withdrew from the course, leaving a sample of forty-six--twenty-two in Group C and twenty-four in Group ST. Group ST consisted of five males and nineteen females. Seven of Group ST were in the physical therapy program, sixteen were prephysical therapy majors, and one was a nursing major. Group C consisted of five males and seventeen females. Four of Group C were in the physical therapy program, sixteen were prephysical therapy majors, one was a nursing major, and one was a dietetics major. These variables are represented in Table 1.

Group	N	Males	Females	P.T.	Pre-P.T.	Nursing	Other
Slide-tape (ST)	24	5	19	7	16	1	-
Computer (C)	22	5	17	4	16	1	1

Table 1. Sample size and characteristics of Group ST and Group C

Note: P.T. = physical therapy

The range of scores, group means, and standard deviations of scores on the final exam are given in Table 2. The degrees of freedom were 44, so that the critical-value for a significant difference at the .05 level was 2.0168. Using the two-tailed independent t-test formula (see Procedures section), the calculated t value was 1.090, or less than the critical t value.

Group	N	Range	M	S.D.
Slide Tape	24	118-178.5	167.19	14.87
Computer	22	120-180.5	162.3	15.40

Table 2. Range of scores, group means, and standard deviations

SIGNIFICANCE OF THE DATA

There is no significant difference in the means (.05 level) of final exam scores of students studying by slide-tape compared to students studying by computer. The research hypothesis was that there would be a difference in the mean test scores. Therefore, the null hypothesis will be accepted that there is no difference in the mean test scores between students learning medical terms by computer-assisted self-study and students using slide-tape modules for self-study.

CONCLUSIONS AND SIGNIFICANCE

Based on this study, students will achieve no more if studying medical terminology by computer than they will studying by slide-tape. Indeed, the literature seems to support the fact that computer-assisted learning is at least as good as learning by traditional methods, but

only in special circumstances has it been found to be better (Pohl, 1981; Masuo, 1981; Chambers, 1980). This study would support computer-assisted learning as another tool available to the instructor, a tool which is proven to be equal to other methods.

Implications for the faculty of the Physical Therapy Program are that students should be given their choice of whether to do self-study in medical terminology by computer or by slide-tape. Meeting a student's preferred style of learning may prevent frustration. Students may even be given the opportunity to switch back and forth, or study by both methods. Results of the study will be shared with other faculty at the University (via the faculty newsletter) so that they may consider these findings when developing their course materials. Personnel at the University computer center may also find this information useful as they direct faculty in use of the computers. In this way the institution will profit from this project.

This study was limited in that it was conducted on only one class of forty-six students. Scores on the final exam tended to be higher than previous years, suggesting a Hawthorne effect. Students may have realized they were part of a study. Also, students may have switched back and forth between studying by computer and studying by slide-tape, despite precautions taken to prevent this. Results of this study relate basically to the slide-tape modules and computer program developed for this specific medical terminology course. Generalization must be taken with care, as other modules or programs may produce different results.

Future studies could include more research of this type on several classes of medical terminology to increase the population size. Pretests could be given to determine if lower aptitude students achieve

more studying by computer, as suggested by Masuo (1981). One could even compare scores of males to females to see if one gender learns easier by computer or slide-tape.

This study is unique in its comparison of computer learning to slide-tape learning. Further studies could be done comparing computer learning to other modes (for example, movies or videocassettes), since it has frequently been compared to traditional modes such as lecture, but infrequently to other media. More research is indicated in this area.

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